REMARKS

Claims 1-18 are pending in the application. Claims 1-18 stand rejected.

Claims 19-53 have been newly added. The new claims are based on the original specification. No new matter has been added. Please charge the amount of $1,518.00 to deposit account 50-1290 for the new claims.

The present invention relates to an interleaving/de-interleaving apparatus and method where data to be transmitted is arranged in a matrix; and randomly rearranged by exchanging data units between rows and between columns, and outputting the rearranged data in time series.

Claims 1-18 are rejected under 35 U.S.C.103(a) as being obvious over Applicants' Admitted prior art in view of Lin et al. (Lin).

Claims 1, 2, 3, 10, 17, 18 are rejected under 35 U.S.C 103(a) as being obvious over Applicants' Admitted prior art in view of Azuma et al. (Azuma).

Claims 1, 2, 3, 10, 17, 18 are rejected under 35 U.S.C 103(a) as being obvious over Applicants' Admitted prior art in view of Yamaguchi et al. ("Turbo Code", a new coding system approaching theoretical Shannon limits, is born in France, NIKKEI ELECTRONICS, July 13, 1988)(Yamaguchi).

Claims 1, 2, 3, 10, 17, 18 are rejected under 35 U.S.C 103(a) as being obvious over Applicants' Admitted prior art in view of Karasawa et al. (Karasawa).

Applicant's admitted prior art describes block interleaving (fig. 22) and random interleave (fig.

23 and 24). Each of the described prior art suffers from a problem when implemented. Namely block interleaving has a problem of difficulty in correcting certain errors caused by fading during transmission. Random interleave also suffers in correcting certain errors resulting from fading during transmission as described on page 6 and also implementing a 256x256 random interleave matrix would prove extremely difficult.

Applicant's claims 1 and 2, as amended, call for an interleaving method and a de-interleaving method each includes a step of *randomly rearranging said data by exchanging data units between rows and between columns*.

Applicant's admitted prior art does not teach or suggest the features of claims 1 and 2.

Lin teaches a type of block interleave and also staggering of resynchronization signals throughout the interleave blocks (col. 2:57-66). Lin teaches inserting the resynch signals following the relationship described in col. 3:5-25. This is different from applicant's claimed invention. Lin does not teach randomly rearranging the data by exchanging data units between rows and between columns.

Azuma describes encoding secret speech into sub-band signals of a plurality of frequency bands. The sub-band signal is permutated and multiplexed. Azuma describes in col. 10:66-68, "in the scramble processing, the rows of this matrix are permutated at random, and the number of combinations is usually N! for an nXn matrix." Azuma does not describe interleaving by exchanging data units between rows and between columns.

Yamaguchi describes the prior art of block interleave and the non-uniform interleave. However as discussed in applicant's specification pages 5-8 these types of interleave are constrained by various problems. Yamaguchi does not suggest the features of applicant's claimed invention, specifically

interleaving by exchanging data units between rows and between columns.

In the Karasawa reference a de-interleave or interleave function for transmitted signals is suggested. In col. 3:8-11 Karasawa teaches interleave by a two-dimensional memory where if the input was applied in a row order the output is in a column order. This is different from applicant's claimed invention claims 1 and 2. Karasawa does not teach interleaving by exchanging data units between rows and between columns.

Claims 1, 2, 3, 10, 17, 18 are rejected under 35 U.S.C 103(a) as being obvious over Karasawa in view of Yamaguchi

Claims 1, 2, 3, 10, 17, 18 are rejected under 35 U.S.C 103(a) as being obvious over Karasawa et al. in view of Azuma et al. (U.S.Patent No.4,959,863).

As described above, none of Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al. describe or suggest the above-described features of applicant's claimed invention. Therefore the subject matter of each amended claims 1 and 2 does not read on nor would be obvious in view of any of Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al., individually or in combination.

Claim 3, as amended, calls for an interleaving apparatus which includes a first storing unit for storing data to be transmitted, and a first control unit for controlling the first storing unit so that the data to be transmitted is outputted from the first storing unit with the data to be transmitted arranged in a matrix and the data to be transmitted *randomly rearranged by exchanging data units between rows and between columns*.

Claim 10, as amended, calls for a de-interleaving apparatus which includes a second storing unit

for storing received data, and a second control unit for controlling the second storing unit so that the received data is outputted from the second storing unit in a state before the received data was interleaved by arranging the received data in a matrix and *randomly rearranging the received data by exchanging data units between rows and between columns*.

Claim 17, as amended, calls for an interleaving/de-interleaving system including an interleaving apparatus which outputs said data to be transmitted with said data to be transmitted arranged in a matrix and *randomly rearranged by exchanging data units between rows and between columns*, and a de-interleaving apparatus which outputs received data in a state before the transmitted data was interleaved by arranging the received data in a matrix and *randomly rearranging the received data by exchanging data units between rows and between columns*.

Claim 18, as amended, calls for interleaving/de-interleaving apparatus which includes (a) an interleaving apparatus for outputting data to be transmitted to an opposite interleaving/de-interleaving apparatus with the data to be transmitted arranged in a matrix, and the data to be transmitted *randomly rearranged by exchanging data units between rows and between columns*, and (b) a de-interleaving apparatus for outputting received data interleaved in the opposite interleaving/de-interleaving apparatus in a state before the received data was interleaved by arranging the received data in a matrix, and *randomly rearranging the received data by exchanging data units between rows and between columns*.

As described above, applicant's claimed invention of claims 1-18 is different from and would not be obvious in view of any combination of Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al. because the prior art is totally silent of the above-described features. Therefore the subject matter of each amended claims 1-3, 10, 17, 18 does not read

on Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al., individually or in combination.

Claims 4-9 depend from amended claim 3, and should be allowed and because they recite the additional features.

Claims 11-16 depend from amended claim 10, and also should be allowed and because they recite the additional features.

New claim 19 calls for an interleaving apparatus, which includes a first storing unit for storing data to be transmitted, and a first control unit having a first write control unit for generating a write address to be used to write the data to be transmitted in the first storing unit with the data to be transmitted arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns and for writing the data to be transmitted in said first storing unit, and the first control unit reads the data to be transmitted stored in said first storing unit according to the order of addresses of the first storing unit.

New claim 31 calls for a de-interleaving apparatus, including a second storing unit for storing said received data, and a second control unit having a second write control unit for generating a write address to be used to write the received data in the second storing unit in a state before the received data was interleaved by arranging the received data in a matrix and randomly rearranging the received data by exchanging data units at least between rows or between columns to write the received data, and the second control unit reads the received data stored in the second storing unit according to the order of addresses of the second storing unit.

These structures each realize a random data rearranging by exchanging data units at least

between rows or between columns of the matrix in a data writing process and a simple data reading by reading the data in the storing unit according to the order of addresses of the storing unit. Namely, the interleaving apparatus and the de-interleaving with sufficient interleaving effects and de-interleaving effects can be realized without a complex read address-counting operation.

None of Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al. teach or suggest the above-described applicant's claimed features. Therefore the subject matter of new claims does not read on Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al., individually or in combination.

New claim 20 calls for an interleaving apparatus, which includes a first storing unit for storing data to be transmitted, and a first control unit having a first write control unit for generating a write address to be used to write the data to be transmitted in the first storing unit with the data to be transmitted arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns and for writing the data to be transmitted in the first storing unit so as to be read the data from the first storing unit according to the order of addresses of the first storing unit.

New claim 32 calls for a de-interleaving apparatus, including a second storing unit for storing said received data, and a second control unit having a second write control unit for generating a write address to be used to write the data to be transmitted in the second storing unit with the data to be transmitted arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns and for writing the data to be transmitted in the second storing unit so as to be read the data from the second storing unit according to the order of addresses of the second storing unit.

These structures also realize a random data rearranging by exchanging data units at least

between rows or between columns of the matrix in a data writing process and a simple data reading by reading the data in the storing unit according to the order of addresses of the storing unit.

Any one of Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al. is totally silent of the above-described applicant's claimed features. Therefore the subject matter of each new claim does not read on Applicants' Admitted prior art, Lin et al., Yamaguchi et al., Karasawa et al. and Azuma et al., individually or in combination.

New claims 21 and 27 depend from new claim 19, new claims 22 and 28 depend from new claim 20, new claims 33 and 39 depend from new claim 31, and new claims 34 and 40 depend from new claim 20. Each dependent claim should be allowed for there dependence upon an allowable base claim and because each recites additional distinguishing features.

New claim 23 calls for an interleaving apparatus, including a first storing unit for storing data to be transmitted, and a first control unit which writes the data to be transmitted in the first storing unit according to the order of addresses of the first storing unit, and the first control unit comprises a first read control unit for generating a read address to be used to read the data to be transmitted from said first storing unit with the data to be transmitted stored in the first storing unit arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns to read the data to be transmitted.

New claim 35 calls for a de-interleaving apparatus, including a second storing unit for storing said received data, and a second control unit which writes the data to be transmitted in the second storing unit according to the order of addresses of the second storing unit, and the second control unit comprises a second read control unit for generating a read address to be used to read the data to be

transmitted from the second storing unit with the data to be transmitted stored in the second storing unit arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns to read said data to be transmitted.

These structures realize a simple data writing by writing the data in the storing unit according to the order of addresses of the storing unit and a random data rearranging by exchanging data units at least between rows or between columns of the matrix in a data reading process. Namely, the interleaving apparatus and de-interleaving apparatus with sufficient interleaving effects and de-interleaving effects can be realized without a complex write address-counting operation.

New claim 24 calls for an interleaving apparatus, including a first storing unit for storing data to be transmitted, and a first control unit having a first read control unit for generating a read address to be used to read the data to be transmitted, written in the order of addresses of said first storing unit, from the first storing unit with the data to be transmitted stored in the first storing unit arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns to read the data to be transmitted.

New claim 36 calls for a de-interleaving apparatus, including a second storing unit for storing said received data, and a second control unit having a second read control unit for generating a read address to be used to read the data to be transmitted, written in the order of addresses of the second storing unit, from the second storing unit with the data to be transmitted stored in the second storing unit arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns to read the data to be transmitted.

These structures also realize a simple data writing by writing the data in the storing unit

according to the order of addresses of the storing unit and a random data rearranging by exchanging data units at least between rows or between columns of the matrix in a data reading process.

New claims 25 and 29 depend from new claim 23, new claims 26 and 30 depend from new claim 24, new claims 37 and 41 depend from new claim 35, and new claims 38 and 42 depend from new claim 36. Each dependent claim should be allowed for there dependence upon an allowable base claim and because each recites additional distinguishing features.

New claim 43 calls for a transmitting apparatus, which includes (a) an error detection encoding unit for encoding an error detecting bit and for adding said error detecting bit to data to be transmitted, (b) an error correction encoding unit for adding the error correcting code, which is to be used for error correction, to said data to be transmitted, sent from said error detection encoding unit, (c) an interleaving unit which includes a first storing unit for storing said data to be transmitted, from said error detection encoding unit, and a first control unit for controlling said first storing unit so that said data to be transmitted is outputted from said first storing unit with said data to be transmitted arranged in a matrix and randomly rearranged by exchanging data units at least between rows or between columns, (d) a signal assembling unit assembles interleaved data from said interleaving unit to form a signal format suited for transmission, and (e) a spreading unit for converting the signal sent from said signal assembling unit into a spread signal using a predetermined spreading code.

New claim 44, which corresponds to the new claim 19, depends from new claim 43, and should be allowed. New claim 45, which corresponds to the new claim 23, also depends from the new claim 43, and should be allowed.

New claim 46 calls for a receiving apparatus, which includes (a) a de-spreading unit for

separating a desired signal from a received signal using a de-spreading code, (b) a data extracting unit for extracting received data from the signal separated by the de-spreading unit, (c) a de-interleaving unit which includes a second storing unit for storing said received data from said de-spreading unit, and a second control unit for controlling said second storing unit so that said received data is outputted from said second storing unit in a state before said received data was interleaved by arranging said received data in a matrix and randomly rearranging said received data by exchanging data units between rows and between columns, (d) an error correction decoding unit for decoding said received data de-interleaved by said de-interleaving unit, and for correcting an error included in said received data using an error correcting code, (e) an error detecting unit for detecting an error detecting bit added when said received data is transmitted on the basis of a bit structure of the error detecting bit previously set.

New claim 47, which corresponds to the new claim 31, depends from new claim 46, and should be allowed. New claim 48, which corresponds to the new claim 35, also depends from new claim 46, and should be allowed.

New claim 49 calls for a transmitting and receiving apparatus including the structure corresponds to the combination of the new claims 43 and 46. Therefore the new claim 49 should be allowed.

New claims 50-53, each of which corresponds to the new claim 44, 45, 47, 48, depend from the new claim 49, and should be allowed.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Versions with markings to show changes made."

In view of the amendments and remarks set forth above, this application is in condition for allowance which action is respectfully requested. However, if for any reason the Examiner should consider this application not to be in condition for allowance, the Examiner is respectfully requested to telephone the undersigned attorney at the number listed below prior to issuing a further Action.

Any fee due with this paper may be charged to Deposit Account No. 50-1290.

Respectfully submitted

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BSM:pm

"Versions with markings to show changes made."

1. (Amended) An interleaving method comprising the steps of:

arranging data to be transmitted in a matrix; and

randomly rearranging [at least either columns or rows of] said data by exchanging data units between rows and between columns, and outputting said rearranged data in time series.

2.(Amended) A de-interleaving method comprising the steps of:

arranging received data having been interleaved in a matrix; and

randomly rearranging [at least either columns or rows of] said data by exchanging data units between rows and between columns, and outputting said data in time series, thereby outputting said received data in the order before said received data was interleaved.

3.(Amended) An interleaving apparatus for interleaving data to be transmitted, comprising:

a first storing unit for storing data to be transmitted; and

a first control unit for controlling said first storing unit so that said data to be transmitted is outputted from said first storing unit with said data to be transmitted arranged in a matrix and [at least either columns or rows of] said data to be transmitted randomly rearranged by exchanging data units between rows and between columns.

4.(Amended) The interleaving apparatus according to claim 3, wherein said first control unit comprises a first write [controlling] control unit for generating a write address to be used to write said data to be transmitted in said first storing unit with said data to be transmitted arranged in a matrix and [at least either columns or rows of said data to be transmitted] randomly rearranged by exchanging data units between rows and between columns and for writing said data to be transmitted in said first storing unit, and said first control unit reads said data to be transmitted stored in said first storing unit in the order of addresses.

7.(Amended) The interleaving apparatus according to claim 3, wherein said first control unit writes said data to be transmitted in said first storing unit in the order of addresses, and said first control unit comprises a first read [controlling] control unit for generating a read address to be used to read said data to be transmitted from said first storing unit with said data to be transmitted stored in said first storing unit arranged in a matrix and [at least either columns or rows of said data to be transmitted] randomly rearranged by exchanging data units between rows and between columns to read said data to be transmitted.

10.(Amended) A de-interleaving apparatus for de-interleaving received data, comprising:

a second storing unit for storing said received data; and

a second control unit for controlling said second storing unit so that said received data is outputted from said second storing unit in a state before said received data was interleaved by arranging said received data in a matrix and randomly rearranging [at least either columns or rows of] said

received data by exchanging data units between rows and between columns.

11.(Amended) The de-interleaving apparatus according to claim 10, wherein said second control unit comprises a second write control unit for generating a write address to be used to write said received data in said second storing unit in a state before said received data was interleaved by arranging said received data in a matrix and randomly rearranging [at least either columns or rows of] said received data by exchanging data units between rows and between columns to write said received data, and said second control unit reads said received data stored in said second storing unit in the order of addresses.

14.(Amended) The de-interleaving apparatus according to claim 10, wherein said second control unit writes said received data in said second storing unit in the order of addresses, and said second control unit has a second read [controlling] control unit for generating a read address to be used to read said received data in a state before said received data was interleaved from said second storing unit by arranging said received data stored in said second storing unit in a matrix and randomly rearranging [at least either columns or rows of] said received data by exchanging data units between rows and between columns and for reading said received data from said second storing unit.

17. (Amended) An interleaving/de-interleaving system comprising an interleaving apparatus for interleaving data to be transmitted and a de-interleaving apparatus for receiving said transmitted data interleaved by said interleaving apparatus to de-interleave said transmitted data, wherein said interleaving apparatus outputs said data to be transmitted with said data to be transmitted arranged in a

matrix and [at least either columns or rows of said data to be transmitted] randomly rearranged by exchanging data units between rows and between columns, and said de-interleaving apparatus outputs received data in a state before said transmitted data was interleaved by arranging said received data in a matrix and randomly rearranging [at least either columns or rows of] said received data by exchanging data units between rows and between columns.

18.(Amended)An interleaving/de-interleaving apparatus for transmitting/receiving interleaved data to/from an opposite interleaving/de-interleaving apparatus, comprising:

an interleaving apparatus for outputting data to be transmitted to said opposite interleaving/de-interleaving apparatus with said data to be transmitted arranged in a matrix, and [at least either columns or rows of]said data to be transmitted randomly rearranged by exchanging data units between rows and between columns; and

a de-interleaving apparatus for outputting received data interleaved in said opposite interleaving/de-interleaving apparatus in a state before said received data was interleaved by arranging said received data in a matrix, and randomly rearranging [at least either columns or rows of] said received data by exchanging data units between rows and between columns.